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REMARKS

This paper is responsive of a Final Office Action mailed on May 15, 2007. Prior to this response, claims 1-3, 5-12, 27, and 29 were pending. After amending claim 1, 8, 27, and 29, claims 1-3, 5-12, 27, and 29 remain pending.

Claims 1-3, 5-12, and 27-28 have been rejected under 35 U.S.C. 103(a) as unpatentable with respect to Barnak et al. ("Barnak"; US Pub 2003/0146479), in view of Kiziliyalli et al. ("Kiziliyalli"; US 6,573,149), Hsu et al. ("Hsu"; US 2002/0142531), and Pan et al. ("Pan"; US 2004/0175910). The Office Action (mailed August 25, 2006) states that Barnak [0030] describes the use of barrier layer that does not contribute to the work function of the gate electrode, and the use of a Cu interface layer overlying the gate electrode, but does not disclose all the gate materials of the claimed invention. The Office Action states that Kizilyalli describes some gate electrode materials and a barrier layer of less than 5 nm. The Office Action acknowledges that Kizilyalli discloses a dielectric barrier, but assets that this stated preference does not detract from the use of well known gate electrode materials. The instant Office Action states that Pan discloses the use of a Cu upper gate layer. The Office Action states that taken together, the references teach all the features of the claimed invention, and one skilled in the art would have been motivated to combine the references because they offer alternative multi-layered gate configurations. This rejection is traversed as follows.

An invention is unpatentable if the differences between it and the prior art would have been obvious at the time of the invention. As stated in MPEP § 2143, there are three requirements to establish a *prima facie* case of obviousness.

> First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and reasonable expectation of success must both be found in the prior art and not based on applicant's disclosure. *In re Vaeck* 947 F.2d 488, 20 USPQ2d, 1438 (Fed. Cir. 1991).

Generally, Barnak is concerned with replacing doped polysilicon as a gate electrode material. To that end Barnak discloses the use of a Ta (n-channel) and TaN (p-channel) gate electrodes [0033]. In one aspect, Barnak mentions that a Cu layer may be formed over the gate electrodes to avoid a silicide process. The use of Cu or silicide does not affect the gate electrode work function. In one embodiment, a thin barrier layer of either TiN or TaN can be used, which does not affect the work function [0034].

Kizilyalli discloses the use of Ta, W, Ti, TiN, and TaN, to replace n-doped polycrystalline, and tungsten silicode to replace the use of p-doped polySi (col. 5, ln. 1-9). Kizilyalli also discloses the use of a high-k dielectric (metal etch barrier) 310 interposed between the gate electrode 410 and the gate dielectric 220. The metal etch barrier materials mentioned are tantalum pentoxide, silicon nitride, or aluminum oxide (col. 4, ln. 43-48).

As noted in the previous Office Action response, neither Barnak nor Kizilyalli explicitly disclose the use of a thin layer of WN that does not contribute to the work function in a gate stack with an overlying second metal. The fact the Kizilyalli discloses the use of W as a gate electrode, has absolutely noting to do with the suitability of WN as a barrier material. WN

has different properties than W, and it is being used for a different purpose. Alternately stated, that fact that a thick layer W has a work function useful as a gate electrode, would not necessarily suggest to an expert in the art that a thin layer of WN is useful as a barrier material.

In [0029] Pan states that the work function of tantalum nitride can be modified by adjusting the nitrogen profile. Paragraph [0031] of Pan discloses an electrode having a Cu portion 60 overlying a tantalum nitride layer 40 with a modified work function. Since the tantalum nitride has a work function, Pan does not disclose a gate electrode where the work function is determined exclusively in response to a second (Cu) metal.

Similar to Barnak, Hsu discloses the use of TiN, TaN, TiTaN, and TaSiN as a barrier 20 between an underlying gate insulator 18 and an overlying copper electrode 44. Additionally, Hsu mentions the use of WN as a barrier material 20 [0015 and 0021]. Hsu is silent of the subject of the barrier metal work function.

With respect to claims 1 and 27, the Barnak/Kizilyalli/Pan/Hsu references have been combined based upon the assumption that the combination of references discloses every element of the claimed invention. Some of the references disclose a multilayer gate electrode where the barrier metal does not contribute to the overall work function. However, even in combination, the references do not explicitly disclose a gate electrode work function exclusively responsive to any of the top (second) metal electrode materials recited in the independent claims, even if Cu is considered.

Even though the combination of references does not disclose a gate electrode with a work function exclusively response to a second metal layer of Cu, claims 1 and 27 has been further amended to delete the recitation of Cu. Therefore, with respect to the third *prima facie*

requirement, even if Barnak/Kizilyalli/Pan/Hsu are combined, the combination does not explicitly disclose every limitation recited in claims 1 and 27. Claims 2-3 and 5-12, dependent from claim 1, enjoy the same advantages.

With respect to claim 29, the Barnak/Kizilyalli/Pan/Hsu references have been combined based upon the assumption that combination of parts covers every limitation recited in claim 29. Of the four references, only Hsu mentions the use of WN as a barrier metal. However, that use is specifically tied to the use of a copper top metal. No inference can be made that WN would be suitable with other metals. More important, none of the references, including Hsu, disclose the use of WN in a multilayer gate electrode, where the work function is exclusively responsive to the second (overlying) metal. Claim 29 has been amended to recite a specific group of second metal that excludes Cu. With respect to the third prima facie argument, the combination of references do not disclose the use of WN as a barrier that does not contribute to the overall work function of the multilayer gate, as recited in claim 29. Neither does the combination disclose a gate electrode having a work function exclusively responsive to a Pt, Pd, Nb, or NbO second metal.

With respect to the first *prima facie* requirement, the Office Action states that one skilled in the art would have been motivated to combine features from the references because they offer alternative multilayered gate configurations. However, even if this statement were correct, it does not explain how an expert in the art could have modified the references in such a way as to describe the claimed invention. As explained above in response to the third *prima facie* requirement, even when combined, the Barnak/Kizilyalli/Pan/Hsu references fail to disclose all of the claimed

invention limitations. The above-quoted statement from Office Action does not explain how even a person with skill in the art could modify the four references to obtain a multilayered gate electrode made from the materials explicitly recited in the claimed invention. A *prima facie* case has not been made that the claimed invention could be realized by modifying the four references. This assertion is true simply because all the Applicant's claim limitations cannot be found in the combination of four references. Alternately stated, the Office Action does not submit any kind of analysis to support the assumption that an expert in art would be motivated to combine different elements from the cited references. The Applicant respectfully submits that a *prima facie* case of obvious cannot be supported by randomly selecting elements from a list of references, as this does not explain how an expert why an expert would select any particular element from a reference, or why the expert would be motivated to combine the selections. A database search for keywords is no substitute for analysis.

Alternately, if the Examiner is relying upon the knowledge of a person with skill in the art to supply motivation lacking the Barnak/Kizilyalli/Pan/Hsu references, then additional evidence must be provided. Notable, when the source or motivation is not from the prior art references, "the evidence" of motive will likely consist of an explanation or a well-known principle or problem-solving strategy to be applied". *DyStar*, 464 F.3d at 1366, 80 USPQ2d at 1649. The Office Action has not supplied any explanation of how an expert would have known of the interactions between specific material combinations so as to modify the four references to yield all the explicit limitations recited in the base claims.

Considered from the perspective of the second *prima facie* requirement, even if an expert were given the Barnak/Kizilyalli/Pan/Hsu

inventions as a foundation, no evidence has been provided to show that there is a reasonable expectation of success in the claimed invention.

In summary, the Applicant respectfully submits that a *prima facie* case of obvious has not been supported, and the Applicant requests that the rejection of claims 1-3, 5-12, 27, and 29 be removed.

It is believed that the application is in condition for allowance and reconsideration is earnestly solicited.

Respectfully submitted,

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